**CRASH DATA RESEARCH CENTER**
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# CALSPAN ON-SITE AMBULANCE CRASH INVESTIGATION
# SCI CASE NO: CA11004

## VEHICLE: 2007 CHEVROLET 3500 EXPRESS VAN
## AMBULANCE BODY: WHEELED COACH TYPE II

## CRASH DATE: FEBRUARY, 2011

## LOCATION: NEW YORK

Contract No. DTNH22-07-C-00043

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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| *16. Abstract*<br>This on-site investigation focused on an ambulance crash that resulted in the death of an 82-year-old male patient. The 2007 Chevrolet 3500 Express Van with a Wheeled Coach Crusader Type II ambulance body was conducting a non-emergency patient transport at the time of the crash with a 2003 Honda Accord. The crash was identified by the Calspan Special Crash Investigations (SCI) team on Tuesday, February 8, 2011. The notification was forwarded to the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) on the same day and was assigned for on-site investigation on February 10, 2011. The SCI team established cooperation with the investigating police agency and the police crash reconstructionist. The Police Crash Report and permission to inspect the ambulance and the Honda were obtained from the involved officers and the ambulance company. The on-site investigation was conducted on February 11, 2011. The investigation consisted of the inspection and documentation of the vehicles and the crash site, interviews with the ambulance company management and the investigating police officer, imaging of the ambulance's Event Data Recorder (EDR) and a review of the ambulance Drive Cam, which recorded the crash. | | | |
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***BACKGROUND***

This on-site investigation focused on an ambulance crash that resulted in the death of an 82-year-old male patient. The 2007 Chevrolet 3500 Express Van with a Wheeled Coach Crusader Type II ambulance body was conducting a non-emergency patient transport at the time of the crash with a 2003 Honda Accord. **Figure 1** is an on-scene image of the crash site depicting the final rest locations of the vehicles. The crash was identified by the Calspan Special Crash Investigations (SCI) team on February 8, 2011. The notification was forwarded to the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) on the same day and was assigned for on-site investigation on February 10, 2011. The SCI team established cooperation with the investigating police agency and the police crash reconstructionist. The Police Crash Report and permission to inspect the ambulance and the Honda were obtained from the involved officers and the ambulance company. The on-site investigation was conducted on February 11, 2011. The investigation consisted of the inspection and documentation of the vehicles and the crash site, interviews with the ambulance company management and the investigating police officer, imaging of the ambulance's Event Data Recorder (EDR) and a review of the ambulance Drive Cam, which recorded the crash events.


**Figure 1**: On-scene image of the crash site and the involved vehicles. (Image obtained from an internet news website.)

The ambulance was driven by a 43-year-old restrained female and was occupied by an unrestrained 27-year-old male Emergency Medical Technician (EMT) and the 82-year-old restrained male patient. The EMT was seated on the right side bench seat monitoring the patient's vital signs at the time of the crash. The patient was restrained on a Stryker ambulance cot by a shoulder harness and three lateral restraints. The northbound ambulance initiated a left turn across the path of a southbound Honda. The front plane of the Honda impacted the rear aspect of the ambulance's right plane. The driver of the ambulance was not injured in the crash. The EMT sustained an unknown lower extremity injury and was treated and released from a local hospital. The patient sustained a multiple blunt force and associated soft tissue injuries.

He was transported to a regional trauma center where he expired approximately five hours after the crash. The Honda's restrained 84-year-old female driver and the restrained 98-year-old male front right passenger sustained police-reported non-incapacitating injuries.

## *CRASH SUMMARY*

### *Crash Site*

The crash occurred at the four-leg intersection of a north/south road and a westbound entrance/exit ramp for a limited access highway. The intersection was controlled by overhead red/amber/green traffic signals. In the ambulance's northbound direction, the road was a six-lane undivided roadway that had three travel lanes in each direction. The right and center northbound lanes were for through-traffic passing through the intersection. The right northbound lane was designated for left-turn-only traffic entering the highway entrance ramp. In the Honda's southbound direction, the road consisted of a three-lane divided roadway with a 7.3 m (24 ft) wide painted center median. The left and center southbound lanes were for through-traffic and the right lane was a designated right-turn-only lane leading to the highway entrance ramp. The one-way westbound entrance ramp measured 6.8 m (22.3 ft) in width. A crescent-shaped gouge mark was identified on the entrance ramp and was attributed to the left front wheel rim of the ambulance. The gouge mark measured 2.1 m (6.9 ft) in length and denoted the post-impact movement of the ambulance. The speed limit in the area of the crash was 72 km/h (45 mph). **Figure 2** is a northbound trajectory view of the ambulance. **Figure 3** is a southbound trajectory view of the Honda.

**Figure 2**: Northbound trajectory view of the ambulance.

**Figure 3**: Southbound trajectory view of the Honda.

### *Pre-Crash*

The crash occurred during the afternoon hours in February 2011. At the time of the crash, it was daylight and the environmental conditions were cloudy. The asphalt road surface was wet. There was an accumulation of plowed snow along the edges of all the travel lanes. The ambulance had responded to a call from an assisted-living center regarding the 82-year-old male

who had fallen and was in need of transport to a local hospital for an evaluation. The patient was loaded onto a backboard, carried from the building and then restrained on an ambulance cot (while still on the backboard). He was then loaded and secured in the ambulance.

The assisted-living center was located approximately1.6 km (1 mile) south of the crash site. The ambulance driver entered the northbound roadway and travelled the short distance to the intersection of the interstate on-ramp. The ambulance was operating without its emergency warning lights or siren activated. The EDR reported speed of the ambulance was 35 km/h (29 mph) five seconds prior to Algorithm Enable (AE). Coincident to the ambulance's travel, the Honda Accord was southbound approaching the intersection. The Honda was in the center lane of travel. The traffic signal was in the green phase for north/south traffic.

The driver steered the ambulance into the left-turn only lane with the intent to turn west and enter the interstate. The EDR data indicated the ambulance decelerated to a speed of 18 km/h (11 mph) 2 seconds prior to AE. The driver of the ambulance initiated a left turn across the path of the Honda. As the driver proceeded through the turn, she accelerated the vehicle. The EDR recorded speed of the ambulance was 19 km/h (12 mph) 1 second prior to AE. A Crash Diagram is included at the end of this technical report.

***Crash***

The center and right aspects of the Honda's front plane impacted the rear aspect of the ambulance's right plane in an L-configuration crash. The directions of force were in the 11 o'clock sector for the Honda and in the 2 o'clock sector for the ambulance. The severity of the crash (delta-V) was calculated by the Damage Algorithm of the WinSMASH program. The calculated total delta-V of the ambulance was 9 km/h (5.6 mph). The longitudinal and lateral delta V components were -5 km/h (-3.1 mph) and -8 km/h (-5.0 mph), respectively. The total delta-V of the Honda was 23 km/h (14.3 mph) with longitudinal and lateral components of -20 km/h (-12.4 mph) and 12 km/h (7.5 mph), respectively. The WinSMASH analysis was considered borderline due to the incompatibility of the stiffness coefficients attributed to the ambulance relative to the location of the impact at the "hard structures" of the rear axle and wheel.

The force of the impact located rearward of the ambulance's center of gravity resulted in a rapid clockwise (CW) rotation of the vehicle in a westward direction across the entrance ramp. The lateral impact and rotation resulted in a weight shift to the left front tire. The left front tire was overloaded and aired out allowing the rim to contact and gouge the pavement. The ambulance came to rest on the ramp facing in an easterly direction, 10.6 m (34.7 ft) from the point of impact. Based on the Drive Cam video, it was then driven forward approximately 4 m (13 ft) to its final rest location. The Honda rotated approximately 180 degrees and came to rest on the west road edge in the snow, 15.0 m (49.2 ft) south of the point of impact. The Honda's frontal

air bags, right side impact air bag and the right Inflatable Curtain (IC) air bag deployed as a result of the crash.

***Post-Crash***

The ambulance driver used the on-board radio to notify the ambulance company of the crash. The police, fire department and emergency medical services were subsequently notified and responded to the crash. The reported response time of the emergency services was six minutes. The ambulance driver exited the vehicle under her own power and was not injured. Following the crash, the EMT rendered care to the patient until the arrival of the first responders. The EMT was reported to be ambulatory at the scene. He was transported to the emergency room of a regional trauma center for the treatment of an unknown lower leg injury.

The force of the impact resulted in damage to the ambulance cot. An alloy casting, adjacent to the locking pin that mated to the floor rail clamp (**Figure 4**) mounted within the ambulance, sheared due to an overload force. This damage allowed the cot's movement to become unrestricted. The patient remained restrained on the cot; however, the cot and patient came to rest on its left side (**Figure 5**). The patient was facing the right bench seat. The forward aspect of the cot was entangled with the antler bracket, jamming the cot in the displaced orientation. The first responders freed the forward aspect of the cot and moved it to the left in order to access the patient's head. The patient was stabilized and unstrapped from the cot and then the cot was removed from the ambulance. The patient, who had previously been restrained on a backboard, was loaded into another ambulance and transported to a regional trauma center. The patient sustained multiple left rib fractures, a left hemothorax, bilateral pulmonary contusions and fractures to his left upper and lower extremities. He expired five hours post-crash.

**Figure 4**: Image of the floor rail clamp located within the ambulance patient compartment.

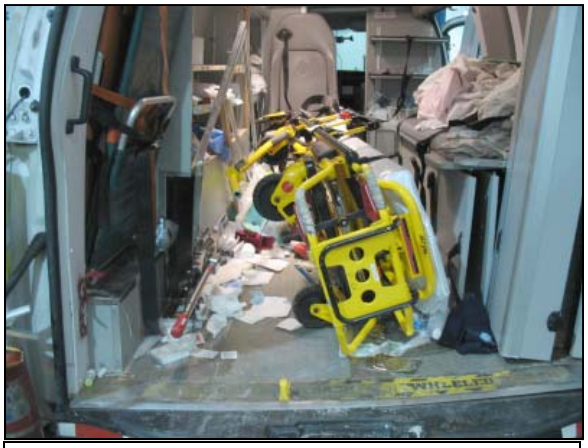


**Figure 5**: Reconstructed post-crash condition of the ambulance cot.

The ambulance and Honda sustained disabling damage and were towed from the crash site. The ambulance was removed to the parent company's base of operations where it was inspected for

this SCI investigation. The Honda was removed to a local tow yard and inspected at that location.

### *2007 CHEVROLET 3500 EXPRESS AMBULANCE*

#### *Description*

The 2007 Chevrolet 3500 Express van was identified by the Vehicle Identification Number (VIN): 1GBHG396771xxxxxx and was manufactured as an incomplete vehicle in June 2007. **Figure 6** is a right rear oblique view of the vehicle. The van was designated as Model: CG33705 and was designed with a 395 cm (155 in) wheelbase. The powertrain consisted of a 6.6-liter, V8 diesel engine linked to a 4-speed automatic transmission with overdrive. The brake system consisted of a front and rear disc system with 4-wheel ABS. The Gross Vehicle Weight Rating was 4,355 kg (9,600 lb) with a front/rear axle split of 2,087 kg (4,600 lb) and 2,760 kg (6,084 lb), respectively. The vehicle was equipped with four Cooper Discovery LT245/75R16 tires. The size of the tires matched the manufacturer's recommendation. The specific tire data measured during the SCI inspection was as follows:

**Figure 6**: Right rear oblique view of the Chevrolet van-based ambulance.

| Tire | Measured Pressure | Measured Tread Depth | Restricted | Damage |
|---|---|---|---|---|
| LF | Flat tire | 8 mm (10/32 in) | No | None, tire debeaded |
| LR | 532 kPa (77 PSI) | 6 mm (8/32 in) | No | None |
| RR | 463 kPa (67 PSI) | 6 mm (8/32 in) | No | None |
| RF | 387 kPa (56 PSI) | 12 mm (15/32 in) | No | 13 cm (5 in) section of wheel rim deformed |

The front interior of the ambulance was configured with front bucket seats and manual 3-point lap and shoulder safety belts. The frontal air bag system consisted of advanced dual-stage air bags for the driver and front right passenger with a manual cut-off switch for the front right seat position. A pass-through into the patient compartment was incorporated into the bulkhead wall behind the front seats.

Wheeled Coach Industries manufactured and installed the Crusader Type II ambulance package in October 2007. The curb weight of the ambulance was placarded as 3,523 kg (7,767 lb) with a

payload of 831 kg (1,833 lb). The patient compartment had a raised fiberglass roof and an interior with a typical layout to include: a double-rear door for cot loading, a three-passenger bench seat along the right side, a right side double door, a rear-facing attendant's seat against the bulkhead wall and multiple cabinets for storage. The police investigation weighed an exemplar Type II ambulance with a set of certified scales and determined its weight to be 3,847 kg (8,480 lb).

The ambulance was equipped with a Drive Cam Video Event Recorder mounted to the center aspect of the windshield. The Drive Cam consisted of a forward-focused camera that provided a "through the windshield view" and a rear-focused camera that provided a view of the ambulance's front occupant compartment. The rear-focused camera also provided a view through the pass-through into the patient compartment; however, that patient compartment was poorly illuminated and minimally focused. The video cameras recorded continuously and synchronously on a short loop during vehicle operation. The video and audio was saved when the vehicle experienced an acceleration event that exceeded a pre-set threshold. The total length of a recorded event was 20 seconds (10 seconds pre-event and 10 seconds post-event).

***Exterior Damage***

The rear aspect of the ambulance's right plane sustained minor impact damage as a result of this intersection collision (**Figure 7**). The direct damage began 411 cm (162.0 in) aft of the right front axle and extended 102 cm (40.0 in) rearward to the right corner of the rear bumper. The induced damage began 287 cm (113.0 in) rearward of the front axle at the trailing edge of the double-door entry to the patient compartment. The combined length of the induced and direct damage measured 226 cm (89 in). At the right rear corner of the patient compartment, the height of the direct contact measured 89 cm (35 in). The residual crush profile at the lower door elevation was as follows: C1 = 8 cm (3.2 in), C2 = 12 cm (4.6 in), C3 = 0, C4 = 0, C5 = 0, C6 = 0. The maximum crush was located at C2. The C3 and C4 crush measurements were located within the right rear wheelhouse (at the tire) and were taken to be zero. The Collision Deformation Classification (CDC) was 02RBEW2.

**Figure 7**: Right side view of the damaged ambulance.

Inspection of the left front wheel/tire revealed that the tire was aired out and debeaded. This occurred due to an overload condition resultant to the weight shift and rotation of the ambulance about the left front wheel. There was no change in the left wheelbase dimension. The right rear

wheel was directly involved in the impact and was contacted by the front of the Honda. Examination of this component revealed that a 13 cm (5 in) section of the rim was deformed 1 cm (0.5 in) inboard as a result of the impact. The right wheelbase dimension increased 1 cm (0.4 in).

The back plane and rear aspect of the left plane were observed to have induced body deformation as a result of the impact. The double rear doors were jammed closed as a result of the impact and forced open. All the other doors remained closed during the crash and were operational post-crash. There was no damage to the windshield or side glazing.

***Event Data Recorder***

The Chevrolet was equipped with an Air bag Control Module (ACM) that had EDR capabilities. The EDR data was imaged at the time of the inspection through the use of the Bosch Crash Data Retrieval scan tool and software version 3.5.1. The data was imaged via a direct connection to the Diagnostic Link Connector located under the left instrument panel of the cab. The imaged data was reanalyzed and reported with software version 4.3 and is attached to end of this report as **Attachment A**.

The EDR recorded a Non-Deployment Event that was related to this crash. The crash occurred on Ignition Cycle 8683 and the data was imaged on Ignition Cycle 8691. The data indicated the driver's safety belt was buckled and the maximum longitudinal delta-V was -2.9 km/h (-1.82 mph). The maximum delta-V occurred 227.5 milliseconds after AE. The EDR recorded 5 seconds of pre-crash Vehicle Speed, Engine RPM and Percent Throttle data and 8 seconds of Pre-crash Brake data. The Pre-crash data indicated the speed of the ambulance was 47 km/h (29 mph) 5 seconds prior to AE. At that time, the vehicle was decelerating with the brakes activated and the throttle closed (0 percent throttle). Two seconds prior to AE, the speed of the ambulance was 18 mph (11 mph). At this time, the brakes were "Off" and the driver began to accelerate. One second prior to AE, the speed of the ambulance was 19 km/h (12 mph), the engine RPM was 1920 and the throttle was 67 percent. This data was consistent with the reconstruction of the ambulance's approach to the intersection and its left turn toward the entrance ramp. The imaged EDR data was also consistent with the time sequence and dynamic data of the Drive Cam video.

***Interior Damage***

Inspection of the front occupant compartment of the ambulance was unremarkable. There was no intrusion or interior damage associated with the exterior crash force. There was no observed evidence of interior occupant contact points.

The driver seat was adjusted to the full-rear track position at the time of the SCI inspection. The at-crash position of the driver seat was unknown. The four-spoke, tilt steering wheel was adjusted to the center position. There was no deformation of the steering wheel rim. There was no separation of the steering column's shear capsules.

***Manual Restraint System***

The 2007 Chevrolet 3500 Express was equipped with manual 3-point lap and shoulder safety belts for the two front seating positions. The driver's safety belt was configured with continuous loop webbing, a sliding latch plate, a height adjustable D-ring, and an Emergency Locking Retractor (ELR). The D-ring was adjusted to the full-up position at the time of the SCI inspection. The webbing was stowed in the retractor upon initial inspection. Examination of the webbing and latch plate revealed historical use consistent with the age of the vehicle. There was no crash-related evidence of use; however, crash-related evidence would not be expected in this lateral crash event. The driver was restrained at the time of the crash based on the observation of the Drive Cam video. Additionally, the imaged EDR data indicated that the driver safety belt was buckled.

***Supplemental Restraint System***

The 2007 Chevrolet 3500 Express was equipped with advanced dual-stage frontal air bags for the driver and front right passenger positions. An OEM manual cut-off switch to suppress the front right passenger air bag was mounted within the center aspect of the instrument panel. The switch was in the "Air Bag On" position. The front air bags did not deploy in this lateral crash.

***Patient Compartment***

The Type II patient compartment was a Crusader model manufactured by Wheeled Coach Industries. The standard layout of the interior featured a rear-facing attendant's seat, an inward facing bench seat along the right wall and multiple storage shelving and cabinetry. All cabinets were constructed of 19 mm (3/4 in) plywood, were trimmed with 3 cm (1 in) aluminum, and had sliding plexi-glass doors. The trim was attached to the cabinets with glued wood dowel fasteners. **Figures 8 and 9** are the initial interior views taken at the time of the SCI inspection prior to removing any items. The cot was loose inside the ambulance floor having been previously removed by the first responders. Numerous supplies had been displaced from the installed cabinetry by the force of the impact.

**Figure 8:** Rear view of the interior of the patient compartment at the time of the SCI inspection.

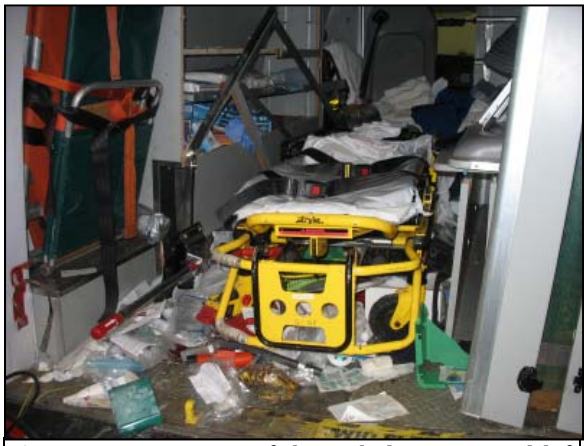


**Figure 9:** Rear view of the ambulance cot and left patient compartment wall.

The attendant's seat was located at the forward left aspect, immediately behind the driver, against the bulkhead wall. The rear-facing seat included an integrated head restraint and was equipped with a fold-down Child Restraint System in the seat back and an integrated 3-point lap and shoulder belt. This seat was not occupied at the time of the crash. Examination of the 3-point safety belt revealed that the webbing was extended and gathered in the D-ring. It appeared that this safety belt may have been used to restrain unknown objects.

The left wall consisted of three upper cabinets and a large four shelf unit at its center aspect. The upper cabinets measured 66 x 29 x 10 cm (26 x 11.5 x 4 in), length x height x depth. The four shelf unit measured 146 x 100 x 29 cm (57.5 x 39.3 x 11.4 in) in overall dimensions and was enclosed by two sets of sliding doors. The contents, sliding doors, and trim pieces of the rear upper cabinet and the four shelf unit were displaced throughout the interior and onto the patient and EMT during the crash. **Figure 10** is a view of the left interior wall of the crashed ambulance. **Figure 11** is a similar left interior view taken of an exemplar ambulance.

**Figure 10**: Interior view of the left wall of the crashed ambulance.

**Figure 11**: Interior view of the left wall in an exemplar ambulance.

A 2.2 kg (5 lb) fire extinguisher was located at the lower left rear aspect of the ambulance, upright on the floor, fastened to the left wall by a band clamp. During the crash, the band clamp deformed and released the fire extinguisher. It was found loose on the floor. The fire extinguisher did not discharge.

An M-size oxygen cylinder was housed within a hinged cabinet located at the rear right aspect of the patient compartment. The cylinder was strapped in place by two 5 cm (2 in) band straps and remained in place. The cylinder was pressurized to 11,404 kPa (1,400 PSI). The quick release hinges of the cabinet door pulled away from the closures due to body deformation.

An inward-facing three passenger bench seat was incorporated into the right side of the patient compartment. The top of the bench was hinged to allow for the under seat storage of pillows,

splints and miscellaneous items. A separate compartment at the forward aspect of the under-bench storage housed the sharps container and a trash receptacle. The bench was equipped with three lap belts attached to the right wall. Each lap belt retracted onto an Automatic Locking Retractor (ALR). The EMT was seated on the bench seat attending to the patient immediately prior to the crash. He was not restrained.

A base cabinet and two open shelves were located at the forward right aspect of the patient compartment. This storage area contained Advanced Life Support (ALS) supplies. The base cabinet measured 58 x 41 x 44 cm (23 x 16 x 17.5 in) width x depth x height. Each shelf measured 56 x 30 cm (22 x 12 in), length x depth. All the items on the open shelves were displaced. The base cabinet remained closed. Two small oxygen cylinders were located on the floor at the inboard side of the base cabinet. These cylinders remained secured in place and were undamaged.

***Patient Cot***

The cot used to transport the patient in this crash was a Stryker Model Number: 6082 MX-PRO R3; Serial Number: 060339888. **Figure 12** is a view of the cot. This cot was constructed of aluminum tubing and was designed for a maximum weight of 295 kg (650 lb). The lower frame of the cot was a scissor design which allowed for height adjustment. The overall dimensions of the cot measured 203 cm (80 in) in length and 58 cm (23 in) in width. The cushion measured 185 cm x 46 cm (73 in x 18 in). The angle of the back rest was set via a pneumatic adjustment. The back rest was flat to accommodate the patient who was laying on a backboard. The patient that was transported reportedly weighed 154 kg (340 lbs) and was within the weight requirements of the cot. The cot was equipped with adjustable side rails. The rearmost vertical support of the left side (relative to the patient) was fractured at its hinged base.

**Figure 12**: View of the Stryker ambulance cot. The location of the locking pin and sheared tubing is identified in the circle.

The cot was equipped with a shoulder harness and three lateral restraint straps. All the cot restraints were in use at the time of the crash. The lateral restraints consisted of adjustable length webbings with a locking latch plate. The fixed ends of the webbing were attached to the side frame of the cot. The lateral restraints were positioned across the legs, hips and chest of the patient. The shoulder harness buckled into the chest restraint. Examination of the webbing straps revealed significant evidence of historical use and wear. Crash related evidence was also observed. The webbing of the lateral restraint located across the patient's hips was abraded by

its locking latch plate. The abrasion was consistent with patient loading. Blood evidence was observed on the left shoulder harness strap and within its locking latch plate.

When secured in the ambulance for transport, the forward lower frame work supporting the cot's front wheels nested in the antler bracket that was attached to the ambulance floor (**Figure 13**). The bracket was secured to the floor of the ambulance by two 10 mm (3/8 in) knurled head cap screws. The forward-most cap screw was sheared off by the first responders in order disentangle the cot from the antler bracket post-crash. The antler bracket was found loose within the patient compartment, the bracket itself was not damaged.

**Figure 13**: View of the antler bracket.

The right rear aspect of the cot was secured to the ambulance by a floor rail clamp. A locking pin that was attached to the lower right tubular frame of the cot, adjacent to the right rear wheel, was secured in the jaw of the clamp. The rail clamp was a Stryker Model 6371 Cot Fastener System (**Figure 14**). This clamp was the manufacturer's recommended fastener. The clamp was mounted to a 10 cm (4 in) steel angle bracket that measured (11.8 in tall x 8 in wide x 5/16 in thickness). The bracket was secured to the floor of the ambulance by three 10 mm (3/8 in) lap screws. The top of the angle bracket was deformed 5 cm (2 in) inboard. The clamp mechanism was operational.

**Figure 14**: View of the floor rail clamp.

The cot's locking pin was positioned on the longitudinal tubular frame member 24 cm (9.5 in) forward of the right rear wheel. The tubular frame was welded to an alloy casting at the wheel joint. For reference, the location of the casting and the locking pin are highlighted in **Figure 12** above. **Figures 15 and 16** are close-up views of the casting. During the crash, the casting sheared due to an overload force. The outer diameter of the sheared casting measured 32 mm (1.25 in). This overload force developed due to the rightward kinematic response (acceleration) of the combined mass of the restrained occupant and the cot to the lateral force of the impact. The locking pin and floor clamp were the primary means to couple and restrain the cot and

patient to the ambulance. The overloaded/fractured lower frame allowed the cot to rotate 90 degrees, with the restrained patient and cot coming to rest on their left side post-crash.


**Figure 15**: Right side view of the locking pin and casting at the right rear wheel.

**Figure 16**: End view of the overloaded casting.

## *2007 CHEVROLET 3500 EXPRESS AMBULANCE OCCUPANTS*

### *Driver Demographics*

| | |
|---|---|
| Age / Sex: | 43 years / Female |
| Height: | Unknown |
| Weight: | Unknown |
| Eyewear: | None |
| Seat Type: | Bucket |
| Seat Track Position: | Unknown |
| Manual Restraint Usage: | 3-point lap and shoulder safety belt |
| Usage Source: | SCI vehicle inspection, EDR, Drive Cam video |
| Air Bags: | No deployment |
| Alcohol/Drug Involvement: | None |
| Egress from Vehicle: | Exited vehicle without assistance |
| Transport from Scene: | Ground ambulance to a Level 1 trauma center |
| Medical Treatment: | Examined and released |

### *Driver Injuries*

The driver was not injured in the crash.

### *Driver Kinematics*

The driver was seated in an upright posture in an unknown track position. She was restrained by the vehicle's 3-point lap and shoulder safety belt. The driver was operating the ambulance

during the non-emergency transport of the patient to a local hospital. As the driver approached the intersection, she applied the vehicle's brakes to decelerate. The driver initiated the left turn and began to accelerate. Based on the Drive Cam video, the driver recognized the possibility of the impending crash 1.5 seconds prior to the impact and continued to accelerate the vehicle.

At impact, the emergency mode of the driver's safety belt retractor locked the belt system. The driver responded to the 2 o'clock direction of force by initiating a right and forward trajectory. The driver loaded the locked safety belt system. The ambulance separated from the impact with a CW rotation. During the rotation, the driver alternately rebounded back into the seat and forward into contact with the locked safety belt riding down the force of the crash. A back pack hanging on a hook behind the driver was displaced by the crash force and contacted the driver on the back of her head displacing her knit hat.

The ambulance came to rest on the entrance ramp. The engine of the vehicle was still running and the ambulance moved forward approximately 4 m (13 ft). The driver brought the vehicle to a control stop and used to the on-board radio to call for assistance. The driver exited the vehicle under her own power. She was transported to a regional trauma center as a precaution and was examined. She was not injured in the crash.

***EMT Demographics***

| | |
|---|---|
| Age / Sex: | 27 years / Male |
| Height: | 178 cm (70 in) |
| Weight: | 64 kg (140 lb) |
| Eyewear: | Sunglasses |
| Seat Type: | Right inward facing seat in the patient compartment |
| Seat Track Position: | Not adjustable |
| Manual Restraint Usage: | None |
| Usage Source: | SCI vehicle inspection, Drive Cam video |
| Air Bags: | None available |
| Alcohol/Drug Involvement: | None |
| Egress from Vehicle: | Exited vehicle without assistance |
| Transport from Scene: | Ground ambulance to a Level 1 trauma center |
| Medical Treatment: | Treated and released |

***EMT Injuries***

| Inj. No. | Injury | Injury Severity (AIS 2005) | Injury Source | Confidence |
|---|---|---|---|---|
| 1 | Unknown lower extremity injury | Unknown (800099.9,9) | Ambulance cot | Probable |

*Source of Injury Data: Interview with responding ambulance medical technician.*

***EMT Kinematics***

The EMT was seated on the forward aspect of the inward facing bench attending to the patient (**Figure 17**). Reportedly, he was recording the patient's vital signs. The EMT responded to the force of the impact by initiating a right lateral trajectory. The EMT was displaced into, and loaded, the right wall of the patient compartment. The subsequent CW rotation of the vehicle displaced the EMT into the right rear corner area of the compartment. The EMT remained in contact with the right corner and rode down the force of the crash.

**Figure 17**: Inward-facing bench seat along the right patient compartment wall.

During the crash event, the cot became displaced and engaged the lower extremities of the EMT. The EMT's contact with the cot resulted in an unknown lower extremity injury. As the vehicle came to rest, the EMT moved from the right rear corner area to the rear-facing attendant's seat based on a review of the Drive Cam video. The EMT then turned and began to assess the patient. He attended to the patient until the arrival of the first responders. The EMT was able to exit the ambulance unassisted and was ambulatory at the scene. He was transported to a regional trauma center, treated and released with a reported unknown lower extremity injury.

***Patient Demographics***

| | |
|---|---|
| Age / Sex: | 82 years / Male |
| Height: | 175 cm (69 in) |
| Weight: | 122 kg (268 lb) |
| Eyewear: | Unknown |
| Seat Type: | Laying supine on a rear-facing cot in the patient compartment |
| Seat Track Position: | Not adjustable |
| Manual Restraint Usage: | Shoulder harness and three lateral straps |
| Usage Source: | SCI vehicle inspection |
| Air Bags: | None available |
| Alcohol/Drug Involvement: | None |
| Egress from Vehicle: | Assisted due to perceived serious injuries |
| Transport from Scene: | Ground ambulance to a Level 1 trauma center |
| Medical Treatment: | Emergency care; expired 5 hours post-crash |

***Patient Injuries***

| Inj. No. | Injury | Injury Severity (AIS 2005) | Injury Source | Confidence |
|---|---|---|---|---|
| 1 | Multiple left side rib fractures - Left 2nd through 10th ribs, fractured posterolaterally, and ribs 3rd through 6th have secondary lateral fractures (flail chest) | Serious (450212.3,2) | Ambulance floor | Certain |
| 2 | Left hemothorax (approximately 350cc of hemorrhage in pleura cavity) | Serious (442200.3,2) | Ambulance floor | Certain |
| 3 | Bilateral pulmonary contusions (minor contusions, more prominent on the left than the right) | Serious (441410.3,3) | Ambulance floor | Certain |
| 4 | Compound fracture of the mid-left humerus (with overlying 2.5 cm laceration at the mid bicep level) | Moderate (751222.2,2) | Ambulance floor | Certain |
| 5 | Compound fracture of the mid to distal left radius (with overlying 16.5 cm superficial laceration, which is up to 6.4 cm wide) | Moderate (752801.2,2) | Ambulance floor | Certain |
| 6 | Compound fracture of the mid to distal left ulna (with overlying 16.5 cm superficial laceration, which is up to 6.4 cm wide) | Moderate (753201.2,2) | Ambulance floor | Certain |
| 7 | Left distal tibia fracture, NFS | Moderate (854331.2,2) | Ambulance floor | Certain |
| 8 | Left distal fibula fracture, NFS | Moderate (854441.2,2) | Ambulance floor | Certain |
| 9 | Nose fracture NFS (bridge of nose palpably fractured) | Minor (251000.1,4) | Interior loose objects displaced from shelves within patient compartment | Probable |
| 10 | Left periorbital contusions (more prominent on the left than right) | Minor (210402.1,2) | Interior loose objects displaced from shelves within patient compartment | Probable |

| Inj. No. | Injury | Injury Severity (AIS 2005) | Injury Source | Confidence |
|---|---|---|---|---|
| 11 | Right periorbital contusions | Minor (210402.1,1) | Interior loose objects displaced from shelves within patient compartment | Probable |
| 12 | Nose abrasion (2.5 cm x 1.9 cm triangular abrasion to the medial left proximal bridge of nose) | Minor (210202.1,4) | Interior loose objects displaced from shelves within patient compartment | Probable |
| 13 | Lower abdominal lacerations (a band of superficial lacerations “stretch lacerations” extends 51 cm across the lower abdomen and ranges in height from 0.6 cm up to 5 cm, which also extend onto the left lateral hip) | Minor (510602.1,8) | Lateral restraints of the cot | Certain |
| 14 | Multiple left upper extremity contusions: mid upper arm (10.2 x 4.4 cm), forearm (3.8 cm in radius, over the dorsal aspect), hand (7.6 x 5 cm, over dorsal aspect) | Minor (710402.1,2) | Ambulance floor | Certain |
| 15 | Multiple right upper extremity contusions: hand (covering hand, on the dorsal aspect), proximal forearm (7.6 x 3.8 cm on dorsal aspect) | Minor (710402.1,1) | Interior loose objects displaced from shelves within patient compartment | Probable |
| 16 | Right anterior knee and lower leg scattered contusions (with the largest individual contusion being 6.3 cm in diameter) | Minor (810402.1,1) | Interior loose objects displaced from shelves within patient compartment | Probable |
| 17 | Multiple left lower extremity contusions: lower leg (15.2 x 10.1 cm on the anterior and lateral lower leg, near the fracture area), foot (covers distal 5 cm of foot , excluding great toe) | Minor (810402.1,2) | Ambulance floor | Certain |

| Inj. No. | Injury | Injury Severity (AIS 2005) | Injury Source | Confidence |
|---|---|---|---|---|
| 18 | Left lateral hip lacerations (superficial lacerations) | Minor (810602.1,2) | Ambulance floor | Certain |
| 19 | Right 1st and 2nd toe abrasions (0.6 cm diameter on the dorsal surface) | Minor (810202.1,1) | Interior loose objects displaced from shelves within patient compartment | Probable |
| 20 | Left foot laceration (1.9 cm laceration on the proximal plantar surface of the 4th and 5th toes) | Minor (810602.1,2) | Ambulance floor | Probable |

*Source of Injury Data: Autopsy Report.*

***Patient Kinematics***

This patient was being transported for a previous fall. He was laying supine on a backboard and was restrained by a shoulder harness and three lateral straps to a rear-facing ambulance cot. The 82-year-old was an end-stage Alzheimer's patient.

At impact, the patient responded to the crash forces by moving on a right lateral trajectory. The patient loaded the webbing straps and the left side rail of the cot. In turn, the combined mass of the patient and cot loaded the rail clamp. This loading was transmitted through the lower frame and locking pin of the cot. The alloy casting at the right rear wheel was overloaded resulting in a fracture of the lower frame at the wheel joint. This separation allowed the cot the freedom to rotate. The cot and patient rotated over onto its left side. The left side of the patient impacted the floor of the ambulance resulting in multiple fractures of the left ribs, left hemothorax, bilateral pulmonary contusions, and the compound fractures of the left upper extremities and fractures of the left tibia and fibula. The displaced patient loaded the lateral restraints resulting in the abdominal "stretch lacerations". Numerous objects stored on the open shelves of the patient compartment were displaced due to the impact force and subsequent rotation of the ambulance. These displaced objects contacted the patient resulting in the nose fracture and the numerous soft tissue abrasions and contusions.

The responding medical personnel freed the cot and removed the patient (while he was still on the backboard). He was transported to a regional trauma center where he expired five hours post-crash.

***2003 HONDA ACCORD***

***Description***

The 2003 Honda Accord 2-door coupe (**Figure 18**) was equipped with EX level trim and was identified by the VIN: 1HGCM82663Axxxxxx. The date of manufacturer was March 2003. The digital odometer reading was unknown due to electrical system damage. The powertrain consisted of a 3.0-liter, 6-cylinder engine linked to a 5-speed automatic transmission with front wheel drive. The Honda was equipped with a 4-wheel ABS, disc brake system. The Honda's OEM 7-spoke alloy wheels were equipped with Bridgestone Turanza EL 41, P205/60R16 tires. The vehicle manufacturer recommended front and rear cold tire inflation pressure was 221 kPa (32 PSI) and 210 kPa (30 PSI), respectively. The specific tire data measured at the time of the SCI inspection was as follows:

**Figure 18**: Front view of the Honda Accord.

| Tire | Measured Pressure | Tread Depth | Restricted | Damage |
|---|---|---|---|---|
| LF | 193 kPa (28 PSI) | 6 mm (8/32 in) | No | None |
| LR | 145 kPa (21 PSI) | 6 mm (7/32 in) | No | None |
| RR | 186 kPa (27 PSI) | 6 mm (8/32 in) | No | None |
| RF | Flat tire | 6 mm (7/32 in) | Yes | Cut in tire tread |

The manual restraint system consisted of 3-point lap and shoulder safety belts in all five seat positions. The front safety belts were equipped with a retractor pretensioner system. The Honda was also equipped with dual stage advanced frontal air bags, front row seat-mounted side impact air bags and side impact IC air bags.

***Exterior Damage***

The exterior of the Honda sustained moderate damage to its frontal plane during the vehicle-to-vehicle crash sequence. **Figure 19** is a view of the direct and induced damage to the front plane of the Honda. The direct contact damage began 19 cm (7.5 in) left of the damaged center and extended 96 cm (37.8 in) to the front right bumper corner. The combined width of the direct and induced damage extended across the full 154 cm (60.6 in) end width of the vehicle.

**Figure 19**: Right front oblique view of the Honda.

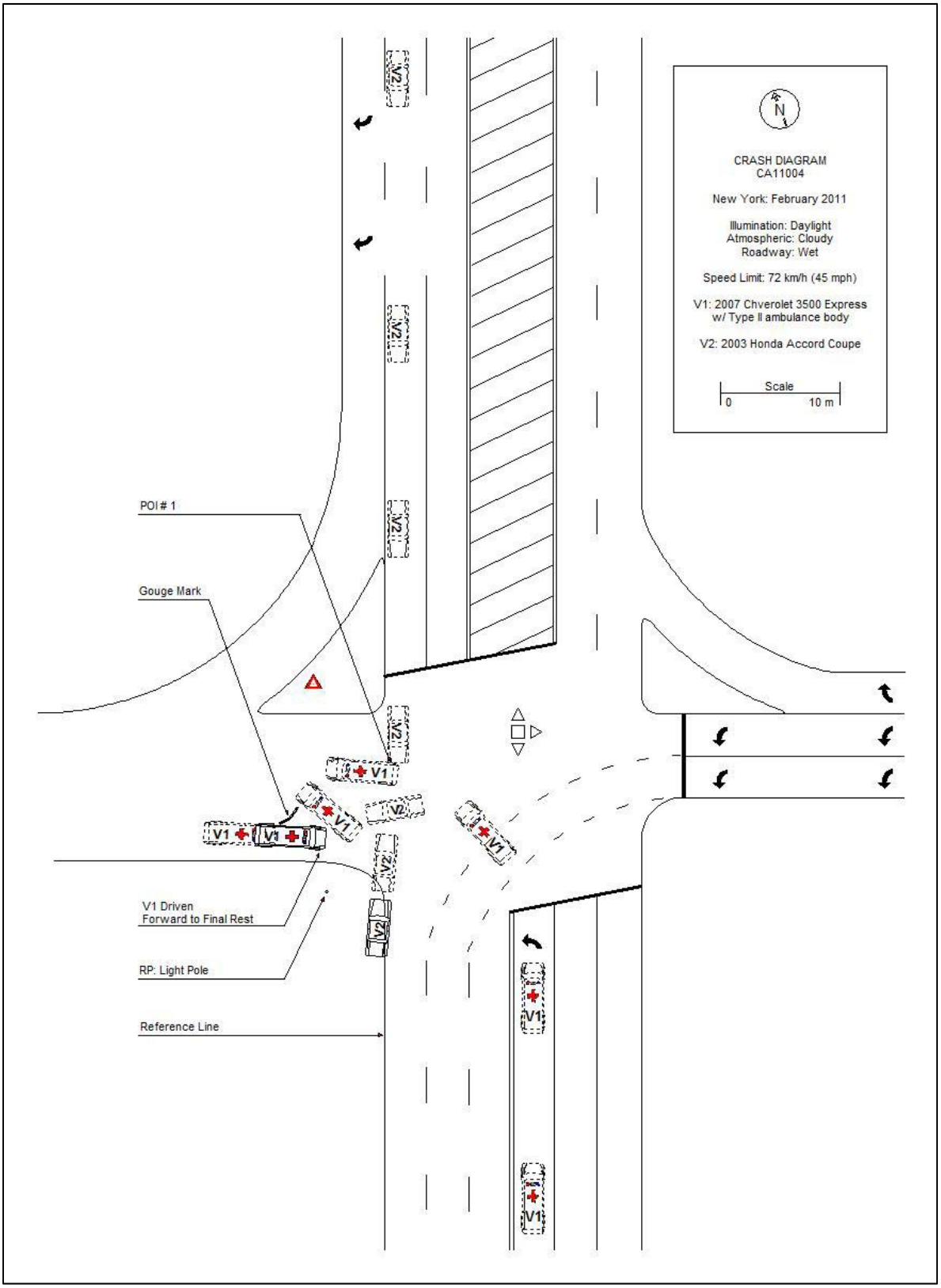
The impact resulted in a mostly longitudinal deformation pattern to the front bumper support bar, radiator, hood and front fenders. The plastic front bumper fascia was separated from the vehicle as a result of impact forces. The Honda's right wheelbase was reduced by 9 cm (3.5 in) in comparison to exemplar measurements. A crush profile measured along the bumper level produced the following results: C1 = 3 cm (1.2 in), C2 = 25 cm (9.8 in), C3 = 39 cm (15.4 in), C4 = 36 cm (14.2 in), C5 = 22 cm (8.7 in), C6 = 21 cm (8.3 in). The maximum crush was located 8 cm (3.1 in) left of C3 and measured 41 cm (16.1 in).

At the time of the SCI inspection, the two doors were latched closed and operational. The post-crash condition of the Honda's window glazing were found to be in place and undamaged from impact forces except for the windshield, which sustained minor fractures without laminate separation. The CDC for this damage pattern was 11FZEW2.

***Occupant Data***

The Honda Accord was driven by a restrained 84-year-old female driver. The front right passenger was a restrained 98-year-old male. These occupants responded to the force of the crash by loading their respective safety belts and the deployed frontal air bags. The occupants of the Honda were removed from the vehicle by the responding medical services and transported to a trauma center with non-incapacitating injuries.

***CRASH DIAGRAM***



**ATTACHMENT A:**

**2007 Chevrolet 3500 Express EDR Data**

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

## CDR File Information

| | |
|---|---|
| User Entered VIN | 1GBHG396771****** |
| User | |
| Case Number | |
| EDR Data Imaging Date | 02/11/2011 |
| Crash Date | |
| Filename | CA11004 CDR.CDRX |
| Saved on | Friday, February 11 2011 at 11:47:08 |
| Collected with CDR version | Crash Data Retrieval Tool 3.5.1 |
| Reported with CDR version | Crash Data Retrieval Tool 4.3 |
| EDR Device Type | Airbag Control Module |
| Event(s) recovered | Non-Deployment |

## Comments

No comments entered.

## Data Limitations

**Recorded Crash Events:**

There are two types of Recorded Crash Events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle longitudinal velocity change. This event will be cleared by the SDM, after approximately 250 ignition cycles. This event can be overwritten by a second Deployment Event, referred to as a Deployment Level Event, if the Non-Deployment Event is not locked. The data in the Non-Deployment Event file will be locked, if the Non-Deployment Event occurred within five seconds before a Deployment Event. A locked Non Deployment Event cannot be overwritten or cleared by the SDM. The second type of SDM recorded crash event is the Deployment Event. It also contains Pre-Crash and Crash data. The SDM can store up to two different Deployment Events, if they occur within five seconds of one another. If multipleNon-Deployment Events occur within five seconds prior to a Deployment Event, then the most severeNon-Deployment Event will be recorded and locked. If multiple Non-Deployment Events precede a Deployment Event, and occur within five seconds of each other (but not necessarily all within five seconds of the Deployment Event), then the most severe of the Non-Deployment Events (which may have occurred more than five seconds prior to the Deployment Event) will be recorded and locked. If a Deployment Level Event occurs within five seconds after the Deployment Event, the Deployment Level Event will overwrite any non-locked Non-Deployment Event. If multiple Non-Deployment Events occur within five seconds prior to a Deployment Event, and one or more of those events was a Pretensioner Deployment Event, then the most recent Pretensioner Deployment Event will be recorded and locked. Deployment Events cannot be overwritten or cleared by the SDM. Once the SDM has deployed an air bag, the SDM must be replaced.

**Data:**

-SDM Recorded Vehicle Longitudinal Velocity Change reflects the change in longitudinal velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Longitudinal Velocity Changeis the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. For Deployment Events, the SDM will record 100 milliseconds of data after Deployment criteria is met and up to 50 milliseconds before Deployment criteria is met. For Non-Deployment Events, the SDM can record up to the first 150 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.

-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.

-SDM Recorded Vehicle Speed accuracy can be affected by various factors, including but not limited to the following:

- -Significant changes in the tire's rolling radius
- -Final drive axle ratio changes
- -Wheel lockup and wheel slip

-Brake Switch Circuit Status indicates the open/closed state of the brake switch circuit.

-Pre-Crash data is recorded asynchronously.

-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if:

- -The SDM receives a message with an "invalid" flag from the module sending the pre-crash data
- -No data is received from the module sending the pre-crash data

-No module present to send the pre-crash data

-Engine Speed is reported at two times the actual value in the following vehicles, if the vehicle is equipped with a 6.6L Duramax diesel engine (RPO LB7, LBZ, LLY, or LMM):

-2001-2006 Chevrolet Silverado
-2007 Chevrolet Silverado Classic
-2001-2006 GMC Sierra
-2007 GMC Sierra Classic
-2006-2007 Chevrolet Express
-2006-2007 GMC Savana
-2003-2009 Chevrolet Kodiak
-2003-2009 GMC Topkick

-Driver's and Passenger's Belt Switch Circuit Status indicates the status of the seat belt switch circuit. If the vehicle's electrical system is compromised during a crash, the state of the Driver's Belt Switch Circuit may be reported other than the actual state.

-The Time between Non-Deployment to Deployment Events is displayed in seconds. If the time between the two events is greater than 25.4 seconds, "N/A" is displayed in place of the time.

-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.

-Multiple Events will indicate whether one or more associated events preceded the recorded event.

-Multiple Events Not Recorded can be used in the followingscenarios:

-If a single event is recorded, this parameter will indicate whether one or more associated events prior to the recorded event was not recorded due to insufficient record space (because there were more events than there were available event records).

-If two associated events are recorded, this parameter for the first event will indicate whether one or more associated events prior to the first event was not recorded due to insufficient record space.

-If two associated events are recorded, this parameter for the second event will indicate whether one or more associated events between the first and second events was not recorded due to insufficient record space.

-All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

**Data Source:**

All SDM recorded data is measured, calculated, and stored internally, except for the following:

-Vehicle Speed, Engine Speed, and Percent Throttle data are transmitted by the Powertrain Control Module (PCM), via the vehicle's communication network, to the SDM.

-Brake Switch Circuit Status data is transmitted by either the ABS module or the PCM, via the vehicle's communication network, to the SDM.

-The Belt Switch Circuit is wired directly to the SDM.

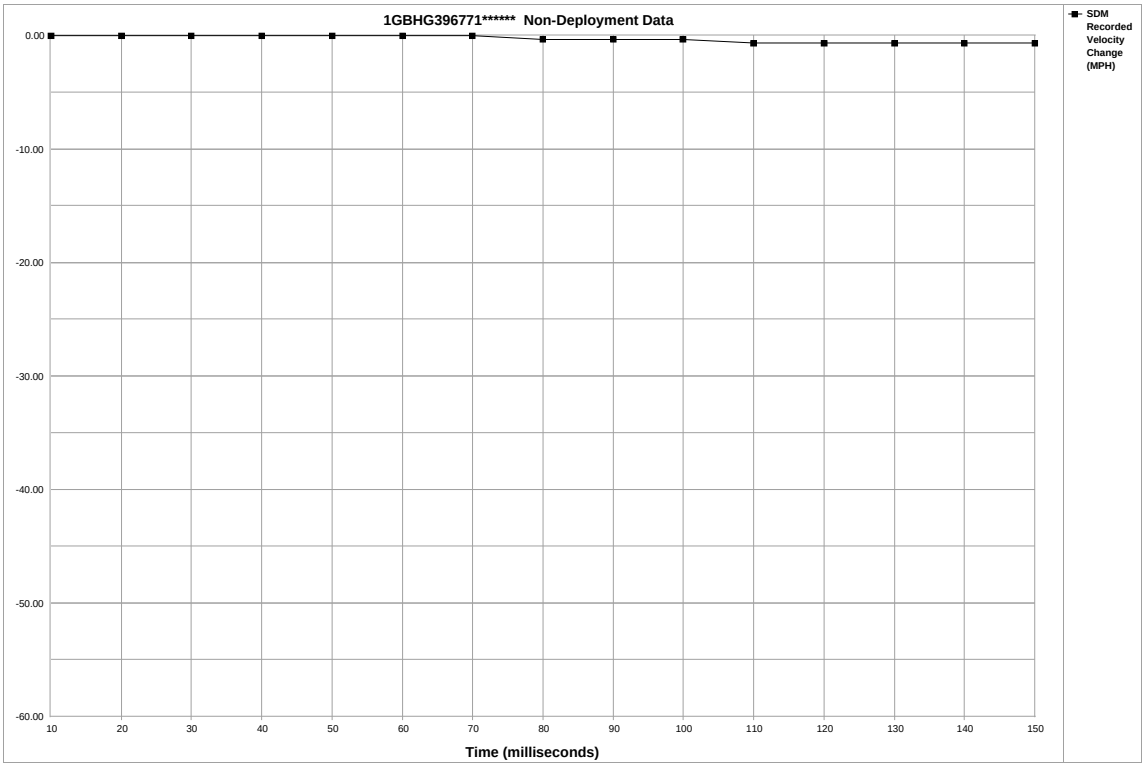
01027_SDMGF_r005

## System Status At Non-Deployment

| | |
|---|---|
| SIR Warning Lamp Status | OFF |
| Driver's Belt Switch Circuit Status | BUCKLED |
| Ignition Cycles At Non-Deployment | 8683 |
| Ignition Cycles At Investigation | 8691 |
| Maximum SDM Recorded Velocity Change (MPH) | -1.82 |
| Algorithm Enable to Maximum SDM Recorded Velocity Change (msec) | 227.5 |
| Crash Record Locked | No |
| Event Recording Complete | Yes |
| Multiple Events | No |
| Multiple Events Not Recorded | No |

| Seconds Before AE | Vehicle Speed (MPH) | Engine Speed (RPM) | Percent Throttle |
|---|---|---|---|
| -5 | 29 | 640 | 0 |
| -4 | 22 | 640 | 0 |
| -3 | 16 | 640 | 0 |
| -2 | 11 | 832 | 58 |
| -1 | 12 | 1920 | 67 |

| Seconds Before AE | Brake Switch Circuit State |
|---|---|
| -8 | ON |
| -7 | ON |
| -6 | ON |
| -5 | ON |
| -4 | ON |
| -3 | ON |
| -2 | OFF |
| -1 | OFF |




| Time (milliseconds) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recorded Velocity Change (MPH) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.31 | -0.31 | -0.31 | -0.62 | -0.62 | -0.62 | -0.62 | -0.62 |

## Hexadecimal Data

Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR system.

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$04  4B 38 54 4B 52 33
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$07  00 00 00 00 00 00
$08  41 44 11 01 58 82
$09  98 4A 32 33 33 31
$0A  00 00 00 00 00 00
$0B  00 00 00 00 00 00
$0C  00 00 00 00 00 00
$0D  00 00 00 00 00 00
$0E  00 00 00 00 00 00
$0F  00 00 00 00 00 00
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$11  80 7F 81 82 81 83
$12  99 00 00 53 53 10
$13  00 01 00 00 00 00
$14  1D 00 00 00 00 08
$15  FA FA FA FA FA FA
$16  FA FA FA FA FA FA
$17  FA FA 00 00 00 00
$18  00 03 01 AC 01 00
$19  10 00 02 00 00 00
$1A  00 00 00 00 00 00
$1B  00 00 00 00 00 00
$1C  00 00 00 00 00 00
$1D  00 00 00 00 00 00
$1F  FF 00 00 00 00 00
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$22  FF FF FF FF FF FF
$23  FF FF FF FF FF FF
$24  00 00 5E 00 5B 14
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$27  00 01 01 01 02 02
$28  02 02 02 00 FB C2
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$2B  FF FF FF FF FF FF
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$39  FF FF FF FF FF FF
$3A  FF FF FF FF FF FF
```

| | | | | | | |
|---|---|---|---|---|---|---|
| $3B | FF | FF | FF | FF | FF | FF |
| $3C | FF | FF | FF | FF | FF | FF |
| $3D | FF | FF | 00 | 00 | 00 | 00 |
| $40 | 00 | 00 | 00 | 00 | 00 | 00 |
| $41 | 00 | 00 | 02 | 02 | 02 | 02 |
| $42 | 02 | 00 | 0A | 0A | 0A | 0A |
| $43 | 0A | 00 | 47 | F8 | 00 | 00 |
| $44 | 13 | 12 | 1A | 24 | 2E | 00 |
| $45 | 3F | 00 | AA | 94 | 00 | 00 |
| $46 | 00 | 00 | 1E | 0D | 0A | 0A |
| $47 | 0A | 00 | 59 | C0 | 00 | 00 |
| $48 | FF | FF | FF | FF | FF | FF |
| $49 | FF | FF | FF | FF | FF | FF |
| $4A | FF | FF | FF | FF | FF | FF |
| $4B | FF | FF | FF | FF | 00 | 00 |
| $4C | FF | FF | FF | FF | FF | FF |
| $4D | FF | FF | FF | FF | FF | FF |
| $4E | FF | FF | FF | FF | FF | FF |
| $4F | FF | FF | FF | FF | 00 | 00 |
| $50 | FF | FF | FF | FF | FF | FF |
| $51 | FF | FF | FF | FF | FF | FF |
| $52 | FF | FF | FF | FF | FF | FF |
| $53 | FF | FF | FF | FF | FF | FF |
| $54 | FF | FF | FF | FF | FF | FF |

## Disclaimer of Liability

The users of the CDR product and reviewers of the CDR reports and exported data shall ensure that data and information supplied is applicable to the vehicle, vehicle's system(s) and the vehicle ECU. Robert Bosch LLC and all its directors, officers, employees and members shall not be liable for damages arising out of or related to incorrect, incomplete or misinterpreted software and/or data. Robert Bosch LLC expressly excludes all liability for incidental, consequential, special or punitive damages arising from or related to the CDR data, CDR software or use thereof.